Sensitivity/Uncertainty Analyses and Other Evaluations to Support SMA Refinement

December 14, 2010

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Presentation Objectives

- Objective: To inform EPA of the Screening Level Sensitivity and SMA Mapping Analyses that the LWG is conducting for further evaluation to refine risk management recommendations and SMAs in the alternatives screening and detailed evaluation of comprehensive alternatives in the FS

Presentation Objectives

- Key Conclusions:
  - EPA’s Focused PRGs represent a starting point for evaluating remedial alternatives, but mapping PRGs for identifying cleanup requires multiple steps, each one with uncertainty
  - A thorough understanding of the assumptions used in the PRG development, and each step in mapping SMAs is needed to create a range of comprehensive alternatives that reflect risk management and environmental protectiveness
  - A number of well understood and readily available methods are proposed to fulfill this risk management need

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Presentation Objectives

- Objective of Screening Level Sensitivity and SMA Mapping Analyses:
  - Support the progression from current EPA delineated AOPCs to refined SMAs
  - Support progression from EPA defined focused PRGs to RGs for the draft FS
  - Inform development of Remedial Action Levels (RALs) necessary to adequately protect human health and the environment for the draft FS

Screening Level Sensitivity and SMA Mapping Analysis

- Consistent with EPA's April 21, 2010 Letter to evaluate:
  - Uncertainty, reliability, strength of EPA's PRGs (covered by the proposed PRG Sensitivity Analyses)
  - Mapping of chemical concentrations for comparison with EPA's PRGs and with consistency with risk assessments
  - Data quality, density, and related mapping issues

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Screening Level Sensitivity and SMA Mapping Analyses

- Includes sensitivity analysis of assumptions used in screening level development
  - Quantitative analysis of risk assessment parameter uncertainty
  - Spatially explicit probabilistic evaluation of non-benthic ecological risks
  - Bioaccumulation model sensitivity analysis

Screening Level Sensitivity and SMA Mapping Analyses

- Includes additional evaluations involving SMA mapping and fate and transport modeling
  - Evaluation of different approaches for establishing background levels
  - Evaluation of impacts of data handling approaches
  - Identification of RALs based on RGs using fate and transport modeling
  - Evaluation of risk reduction over time provided by different RGs and associated RALs

Screening Level Sensitivity Analyses

- Evaluate sensitivity of assumptions used in development of screening levels and in identification and mapping of SMAs
  - Sensitivity Analysis of Human Health Risk Assessment
  - Sensitivity Analysis of Ecological Risk Assessments
  - Sensitivity Analysis of Bioaccumulation Modeling
- Results used to assess protectiveness and support alternatives development

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Focused PRG Sensitivity Analyses

Human Health Risk Assessment Sensitivity Analysis

- Evaluate distributions of parameters to assess the assumptions associated with scenarios and chemicals that are basis of EPA's focused PRGs
  - Smallmouth Bass Consumption for PCBs
  - Clam Consumption for Benzo(a)pyrene
  - In-Water Sediment direct Contact for cPAHs
- Analysis may be expanded to include other exposure scenarios and chemicals as necessary

Focused PRG Sensitivity Analyses

Ecological Risk Assessment Sensitivity Analysis

- Evaluate individual parameter distributions to asses uncertainty in ecological risk assessment assumptions
- Evaluate chemicals and receptors that are basis of EPA's focused PRGs and other screening levels used for SMA mapping
- Evaluate uncertainties with benthic risk approach

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Bioaccumulation Modeling Sensitivity/Uncertainty Analysis

- Conduct sensitivity analysis for the food web model (FWM)
  - Quantify sensitivity of HH PCB smallmouth bass EPA focused PRG to FWM uncertainty
  - Quantify sensitivity of mink PCB EPA PRG to FWM uncertainty
- Examine sensitivity of EPA's PRGs and AOPCs based on statistical bioaccumulation models for benzo(a)pyrene

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SMA Mapping Evaluations

Key Lines of Evidence (LOE)

- Non-risk LOEs being evaluated that impact SMA mapping
  - Issues in mapping screening levels to define SMAs
  - Background level uncertainty and its relationship to SMA mapping
  - Fate and transport assisted approaches to SMA mapping
  - Evaluations of risk reduction over time to define SMAs

SMA Mapping Evaluations
Screening Level Mapping Analyses

- Per EPA’s April 21, 2010 letter evaluate:
  - Uncertainty, reliability, strength of EPA’s PRGs (covered above by PRG Sensitivity Analyses)
  - Mapping of chemical concentrations for comparison with EPA’s PRGs and with consistency with risk assessments
  - Expected current or likely future exposures
  - Data quality, density, and related mapping issues
  - Comprehensive benthic approach
    - Benthic discussions underway
    - Uncertainty will need to be defined once approaches/ models determined

SMA Mapping Evaluations

Additional Screening Level Mapping Analyses

- Evaluate impact of hill topping algorithm and replacement values
  - Impact on surface area
  - Impact on volume
- Evaluate impact of non-detects handling procedures
- Evaluate impact of natural neighbors contouring methods
- Evaluate impact of using organic-carbon normalized screening levels as compared to dry weight screening levels

SMA Mapping Evaluations

Background Level Analyses

- Evaluate additional statistical approaches for upstream data analyses
- Evaluate impact of outlier identification and removal in upstream data set
- Evaluate impact of non-detect handling in upstream data set
- Evaluate impact of organic-carbon normalized approaches
- Evaluate alternative approaches for establishing anthropogenic background levels

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SMA Mapping Evaluations

Fate and Transport Indicators

- EPA December 2009 comments indicate:
  - "In addition, the use of background concentrations as replacement values in the hill topping analysis is inappropriate. Ideally, the fate and transport model can be used to estimate the surface sediment contaminant concentration following recontamination by upstream material…The degree of active remediation performed at the site will have a direct effect on the post remedy contaminant concentrations."
- Per EPA's comments, use the fate and transport model to predict the long-term surface sediment concentrations attained by different active remedy areas
- Active remedy areas can be compared and related to specific screening levels considering their range of uncertainties

SMA Mapping Evaluations

Risk Reduction Over Time Analyses

- Compare potential active remedy areas based on various screening levels and considering screening level uncertainties
- Evaluate changes in sediment concentration of key chemicals over time relative to key screening levels and considering their uncertainties
- Determine time to achieve screening levels considering screening level uncertainties
- Includes a model-based evaluation of short-term risks associated with remedial action (e.g., dredging resuspension)
- Evaluate differences in risk reduction over time and costs between alternate screening levels considering their uncertainties

Example SMA Mapping Analysis

Detection Limit Assumptions

- To illustrate the potential benefits to remedy evaluation decisions, an example of one LOE is presented here
- The current FS data rules require that FS database non-detects for sums be included in summation as half the detection limit (ND=1/2 the DL), consistent with RA procedures
- Although the RA summing rules have been used with the FS dataset to date, it is important to:
  - Understand the resulting overestimation of SMA sizes created
  - Consider other equally valid approaches to define SMAs

Example SMA Mapping Uncertainty Analysis
Detection Limit Assumptions

- The LWG does not support the use of EPA's focused PRGs without the above sensitivity analysis and further evaluations
- However, PCBs are clearly important to determination of SMAs at the site. PCBs used in this example.
- A substantial number of total PCB values in the database include large numbers of non-detects in the sum
- There is a high degree of uncertainty surrounding the calculated total PCB value in these cases, which results in uncertainty in the mapped PCB concentrations in some areas
- To preliminarily understand this uncertainty, the total PCB data set was calculated assuming 0 for non-detects in PCB sums (ND=0) and compared to the ND=1/2 summing approach

Detection Limit Assumption Comparison

Total PCBs (ND = 0) µg/kg	Count	Average % Difference
0 - 10	260	171%
10.01 - 30	374	70%
30.01 - 50	139	47%
50.01 - 100	145	30%
100.01 - 200	105	31%
200.01 - 400	64	13%
400.01 - 676	26	17%
676.01 - 1000	23	12%
> 1000	49	6%

- Average % difference between ND=0 and ND=1/2 approaches

Detection Limit Assumption Comparison

Area	Total PCBs (ND = 0) Surface-weighted Average Concentration (µg/kg)	Total PCBs (ND = 1/2) Surface-weighted Average Concentration (µg/kg)	% Difference
1.9-2.5	94	107	14%
2.5-3.5	14	20	44%
3.5-4.5	53	64	22%
4.5-5.5	16	26	56%
5.5-6.5	28	35	26%
6.5-7.5	76	82	8%
7.5-8.5	32	39	21%
8.5-9.5	90	103	15%
9.5-10.5	47	57	23%
10.5-11.5	84	94	12%
11.5-11.8	29	34	19%
Swan Island	528	563	7%
Study Area	73	83	14%

Presentation Conclusions

- EPA's Focused PRGs represent a starting point for evaluating remedial alternatives
- Application of EPA's Focused PRGs alone do not define the only protective scenario
- Progression from PRGs towards RALs based on risk management principles needs to be initiated
- A thorough understanding of the assumptions used in screening level and SMA development is needed to create a range of comprehensive alternatives that inform and support risk management decision making
- A number of well understood and readily available methods are proposed to fulfill this risk management need

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